

What is claimed is:

1. A method of evaluating an undersaturated coalbed methane reservoir comprising the steps of:

- 5 a. accessing a well admitted to an undersaturated coalbed methane reservoir;
- b. sampling formation water from said undersaturated coalbed methane reservoir;
- c. conducting a test based on said formation water sample;
- 10 d. inductively quantifying a methane content characteristic of sorbed methane that is sorbed in a solid formation substance from said water sample; and
- e. characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic.

15 2. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of capturing substantially pure formation fluid.

20 3. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of assuring that said formation water sample is representative of fluid from said undersaturated coalbed methane reservoir.

25

4. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 3 wherein said step of assuring that said formation water sample is representative of fluid from said undersaturated coalbed methane reservoir comprises the step of producing at least a well pathway volume of fluid.

30

5. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 3 wherein said step of assuring that said formation water sample is representative of fluid from said undersaturated coalbed methane reservoir comprises the step of producing at least a well tubing volume of fluid.

5

6. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 3 wherein said well has a well bottom and wherein said step of assuring that said formation water sample is representative of fluid from said undersaturated coalbed methane reservoir comprises the steps of:

10

- a. ceasing production on said well for a period of time; and
- b. allowing equilibrium methane conditions to be established at said well bottom.

15

7. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 3 wherein said well has a well bottom, wherein said coalbed methane reservoir has a natural reservoir pressure at said well bottom location, and a well bottom pressure and wherein step of assuring that said formation water sample is representative of fluid from said undersaturated coalbed methane reservoir comprises the step of permitting said well bottom pressure to substantially equal said natural reservoir pressure.

20

8. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 and further comprising the step of having a constant fluid production from said well at the time of said sampling.

25

9. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said well has a well bottom and wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of collecting a single phase fluid from about said well bottom.

30

10. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of effecting only a small drawdown.

5

11. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 10 wherein said step of effecting only a small drawdown comprises the step of effecting only a small drawdown for a long period of time.

- 10 12. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 11 wherein said step of effecting only a small drawdown for a long period of time comprises the step of effecting only a small drawdown for a period of time selected from a group consisting of about one week, several days, about one day, longer than a traditional formation water sampling time.

15

13. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 10 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling formation water after a period of nonproduction from said well.

20

14. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling formation water until a gas-water ratio of said water is constant.

25

15. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of contained sampling said formation water.

30

16. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 15 wherein said step of contained sampling said formation water comprises the step of uncased drill stem sampling.
- 5 17. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 15 wherein said step of contained sampling said formation water comprises the steps of:
- a. lowering a tool in said well;
 - b. isolating a sampling area by packing; and
 - 10 c. transporting a sample to a surface in a drill pipe.
18. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 and further comprising the steps of:
- 15 a. permitting a pressure in said undersaturated coalbed methane reservoir to go below a critical desorption pressure of said undersaturated coalbed methane reservoir; and
 - b. affirmatively allowing pressure to in said undersaturated coalbed methane reservoir to naturally rebuild to a pressure above said critical desorption pressure of said undersaturated coalbed methane reservoir prior to
 - 20 accomplishing said step of sampling formation water from said undersaturated coalbed methane reservoir.
19. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 15 wherein said step of accessing a well admitted to an undersaturated
- 25 coalbed methane reservoir comprises the step of pumping a fluid from said well.
20. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 19 wherein said step of contained sampling said formation water comprises the step of isolating said formation water both before and after it is
- 30 subjected to said step of pumping a fluid from said well.

21. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 19 wherein said step of pumping a fluid from said well comprises the step of pumping adjacent said undersaturated coalbed methane reservoir.
- 5 22. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 19 wherein said step of pumping a fluid from said well comprises the steps of:
- a. pumping at a location remote from said undersaturated coalbed methane reservoir; and
- 10 b. avoiding a phase separation prior to accomplishing said step of pumping a fluid from said well.
23. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 19 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of avoiding a pressure drop below a bubble point of said formation water prior to accomplishing said step of pumping a fluid from said well.
- 15
24. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 19 wherein said well has a well bottom and wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of maintaining said well bottom at at least a bubble point of said formation water.
- 20
25. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 15 wherein said step of contained sampling said formation water comprises the step of contained sampling both formation water and gas from said well at a surface.
- 25
26. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 3 and further comprising the step of determining if said well has a slow
- 30

production rate, and wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the steps of:

- a. permitting an inappropriately low pressure not representative of conditions naturally occurring for said undersaturated coalbed methane reservoir;
- 5 b. allowing said undersaturated coalbed methane reservoir to rebuild pressure to a pressure appropriately representative of conditions naturally occurring for said undersaturated coalbed methane reservoir;
- c. producing at least one well pathway volume of fluid; and then
- d. sampling formation water from said undersaturated coalbed methane
10 reservoir.

27. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of on-site testing of said formation water.

15 28. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of determining a gas-water ratio of said formation water.

20 29. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 28 wherein said step of determining a gas-water ratio of said formation water comprises the step of directly testing said gas-water ratio of said formation water.

25 30. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 29 wherein said step of directly testing said gas-water ratio of said formation water comprises the step of on-site testing of said formation water.

31. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 30 wherein said step of on-site testing of said formation water comprises the step of conducting a surface test of said formation water.
- 5 32. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 31 wherein said step of conducting a surface test of said formation water comprises the step of capturing gas from said undersaturated coalbed methane reservoir.
- 10 33. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 28 wherein said step of determining a gas-water ratio of said formation water comprises the step of testing the total gas content of said formation water.
- 15 34. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 28 wherein said step of determining a gas-water ratio of said formation water comprises the step of deducing said gas-water ratio of said formation water.
- 20 35. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 34 wherein said step of deducing said gas-water ratio of said formation water comprises the steps of:
- a. measuring gas factors at a plurality of pressures; and
 - b. creating a curve based at least in part on said step of measuring gas factors at a plurality of pressures.
- 25 36. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of determining a bubble point of said formation water.
- 30 37. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 36 wherein said step of determining a bubble point of said formation

water comprises the step of directly testing said bubble point of said formation water.

38. A method of evaluating an undersaturated coalbed methane reservoir as described
5 in claim 37 wherein said step of directly testing said bubble point of said formation water comprises the step of on-site testing of said formation water.

39. A method of evaluating an undersaturated coalbed methane reservoir as described
10 in claim 38 wherein said step of directly testing said bubble point of said formation water comprises the step of conducting a surface test of said formation water.

40. A method of evaluating an undersaturated coalbed methane reservoir as described
15 in claim 39 wherein said step of directly testing said bubble point of said formation water comprises the step of testing said formation water during drilling.

41. A method of evaluating an undersaturated coalbed methane reservoir as described
in claim 39 wherein said step of directly testing said bubble point of said formation water comprises the steps of:
20 a. releasing pressure from a contained volume; and
b. observing a change resulting from said release of pressure.

42. A method of evaluating an undersaturated coalbed methane reservoir as described
25 in claim 41 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of contained sampling said formation water.

43. A method of evaluating an undersaturated coalbed methane reservoir as described
30 in claim 38 wherein said step of directly testing said bubble point of said formation water comprises the step of acoustically testing.

44. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 38 wherein said step of directly testing said bubble point of said formation water comprises the step of sensing a differential pressure drop.
- 5 45. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 36 wherein said step of inductively quantifying a methane content characteristic of sorbed methane that is sorbed in a solid formation substance from said water sample comprises the step of using a bubble point of said formation water to imply a critical desorption pressure of said undersaturated coalbed methane reservoir.
- 10
46. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 36 wherein said step of determining a bubble point of said formation water comprises the step of assuming all gas sorbed in said formation water is methane.
- 15
47. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 36 wherein said step of determining a bubble point of said formation water comprises the step of directly testing said bubble point of said formation water.
- 20
48. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 36 wherein said step of determining a bubble point of said formation water comprises the step of deducing said bubble point of said formation water.
- 25
49. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the steps of:
- 30 a. measuring gas factors at a plurality of pressures; and
- b. creating a curve based at least in part on said step of measuring gas factors at a plurality of pressures.

50. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of utilizing publicly available, predetermined data similar to data of the solubility of methane in water at various pressures for a given temperature.

51. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of utilizing the mathematical functional relationship of solution gas-water ratio as a function of pressure with constants from publicly available predetermined data.

52. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of combining functional foundations of a plurality of relationships to achieve a predicted relationship of bubble point to pressure of the desired pressure range applicable to the particular situation.

53. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the steps of:

- a. extrapolating beyond measured data; and
- b. utilizing an expected zero crossing point.

54. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of ignoring corrections to data for temperatures of less than one hundred degrees Fahrenheit.

55. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of ignoring corrections to data for other than fresh water.
- 5 56. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of ignoring corrections to data for sorbed gas other than methane.
- 10 57. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the step of utilizing publicly available, predetermined values for various temperature effects.
- 15 58. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 49 wherein said step of deducing said bubble point of said formation water further comprises the step of accomplishing a curve fitting function to a given set of data points.
- 20 59. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 58 wherein said step of accomplishing a curve fitting function to a given set of data points comprises the step of utilizing a cubic equation.
- 25 60. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 48 wherein said step of deducing said bubble point of said formation water comprises the steps of:
- a. utilizing predetermined data having a lowest pressure at a pressure greater than that of interest; and
- b. extrapolating from said lowest pressure for said predetermined data to a
- 30 substantially zero value at a zero pressure to obtain data applicable to a pressure of interest.

61. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 60 wherein said step of utilizing predetermined data having a lowest pressure at a pressure greater than that of interest comprises the step of utilizing salinity-based predetermined data.
62. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of factoring in composition of said formation water.
63. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 62 wherein said step of factoring in composition of said formation water comprises the step of utilizing a salinity for said formation water.
64. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 62 wherein said step of factoring in composition of said formation water comprises the step of testing a composition of said formation water.
65. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 62 wherein said step of factoring in composition of said formation water comprises the step of inferring a composition for said formation water.
66. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 65 wherein said step of inferring a composition for said formation water comprises the step of utilizing data for nearby formation water.
67. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 64 wherein said step of testing a composition of said formation water comprises the step of testing a composition of said formation water for only a limited number of wells in a reservoir area.

68. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of determining a naturally occurring temperature for said formation water.

5

69. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 68 wherein said step of determining a naturally occurring temperature for said formation water comprises the steps of:

a. assessing a well depth; and

10 b. utilizing an applicable geothermal temperature gradient for said well depth.

70. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 68 wherein said step of determining a naturally occurring temperature for said formation water comprises the step of directly measuring a well temperature.

15

71. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of conducting a test based on said formation water sample comprises the step of capturing gas from said undersaturated coalbed methane reservoir.

20

72. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 71 wherein said step of conducting a test based on said formation water sample comprises the step of separating gas and formation water from said well.

25

73. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 72 wherein said step of separating gas and formation water from said well comprises the step of utilizing a bubble pail apparatus on site.

30

74. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 72 wherein said step of separating gas and formation water from said

well comprises the step of utilizing a separation barrel apparatus and an orifice well tester on site.

75. A method of evaluating an undersaturated coalbed methane reservoir as described
5 in claim 72 wherein said step of conducting a test based on said formation water sample further comprises the step of accounting for gas remaining dissolved in said formation water at surface conditions.
76. A method of evaluating an undersaturated coalbed methane reservoir as described
10 in claim 72 wherein said step of conducting a test based on said formation water sample comprises the steps of:
- a. factoring in a surface temperature effect; and
 - b. factoring in a surface pressure effect.
- 15 77. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 72 wherein said step of conducting a test based on said formation water sample comprises the step of ignoring a correction for gas remaining dissolved in said formation water in surface conditions.
- 20 78. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 71 wherein said step of conducting a test based on said formation water sample comprises the step of factoring in composition of gases obtained from said well.
- 25 79. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 78 wherein said step of factoring in composition of gases obtained from said well comprises the step of testing a composition of said gas for only a limited number of wells in a reservoir area.

80. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 71 wherein said step of conducting a test based on said formation water sample comprises the steps of:

- a. releasing a limited amount of pressure from a contained volume; and
- b. observing a pressure buildup within said contained volume.

81. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 78 wherein said step of conducting a test based on said formation water sample comprises the step of testing for contaminants present in a sample.

82. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 81 wherein said step of testing for contaminants present in a sample comprises the step of comparing data from a sample from said well to other data in a reservoir area.

83. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 78 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of additionally sampling formation water from said undersaturated coalbed methane reservoir if any contaminants are deemed to be present.

84. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of inductively quantifying a methane content characteristic of sorbed methane that is sorbed in a solid formation substance from said water sample comprises the step of inferring a critical desorption pressure for a methane-containing solid from said step of conducting a test based on said formation water sample.

85. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of inductively quantifying a methane content characteristic of sorbed methane that is sorbed in a solid formation substance from

said water sample comprises the step of utilizing an inverse gas-water ratio functional relationship.

86. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of determining a likely amount of methane production available from said well upon production.

87. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 86 wherein said step of determining a likely amount of methane production available from said well upon production comprises the step of utilizing an inferred critical desorption pressure for a solid within said undersaturated coalbed methane reservoir.

88. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 87 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir.

89. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir comprises the step of utilizing data representative of a Langmuir isotherm.

90. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 89 wherein said step of utilizing data representative of a Langmuir isotherm comprises the step of fitting a curve for a Langmuir isotherm to measured data for said well.

91. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir comprises the step of utilizing publicly available, predetermined isotherm data.

5 92. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir comprises the step of utilizing data determined for another well within a reservoir area.

10 93. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir comprises the step of utilizing coal-type ranked data.

15 94. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 93 wherein said step of utilizing coal-type ranked data comprises the steps of:

- 20 a. converting from production values to create data representative of amount of gas as a function of pressure;
- b. determining appropriate Langmuir-type parameters;
- c. applying said appropriate Langmuir-type parameters to said data;
- d. creating an approximate gas-water functional relationship for said formation water from said undersaturated coalbed methane reservoir; and
- 25 e. utilizing said approximate gas-water functional relationship for said undersaturated coalbed methane reservoir in characterizing said undersaturated coalbed methane reservoir.

30 95. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm

for said undersaturated coalbed methane reservoir comprises the step of utilizing isotherm data for a different well in a same reservoir area.

5 96. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 88 wherein said step of utilizing a saturated coalbed methane isotherm for said undersaturated coalbed methane reservoir comprises the step of creating an approximate isotherm for said undersaturated coalbed methane reservoir.

10 97. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 96 wherein said step of creating an approximate isotherm for said undersaturated coalbed methane reservoir comprises the steps of:

- a. utilizing at least one measured data point;
- b. utilizing an expected zero crossing point; and
- c. fitting an anticipated curve shape to said data points.

15 98. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 96 wherein said step of creating an approximate isotherm for said undersaturated coalbed methane reservoir comprises the step of utilizing a Langmuir-type curve shape.

20 99. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of estimating a dewatering value for said reservoir.

25 100. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 and further comprising the step of commercially producing methane from said well.

30 101. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of characterizing said coalbed methane reservoir

based upon said inductively quantified methane content characteristic comprises the step of determining an approximate drop in reservoir pressure needed for gas to be produced from said well.

5 102. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of estimating an economic factor for commercial production from said well.

10

103. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 102 wherein said step of estimating an economic factor for commercial production from said well comprises the step of prioritizing a plurality of wells based on economic considerations.

15

104. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of comparing said well to screening criterion.

20

105. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 104 wherein said step of comparing said well to a screening criterion comprises the step of comparing said well to a screening criterion selected from a group consisting of: a screening criterion based upon a reservoir pressure, a
25 screening criterion based upon a permeability of said undersaturated coalbed methane reservoir, a screening criterion based upon the apparent critical desorption pressure of coal in said undersaturated coalbed methane reservoir, a screening criterion based upon the estimated dewatering needs of said undersaturated coalbed methane reservoir, a screening criterion based upon the
30 degree of undersaturation of said undersaturated coalbed methane reservoir, a

screening criterion based upon current prices of gas, a screening criterion based upon projected prices of gas, and a set value of gas content.

106. A method of evaluating an undersaturated coalbed methane reservoir as described
5 in claim 1 and further comprising the step of commercially producing methane from a well that had previously been deemed to be uneconomic.
107. A method of evaluating an undersaturated coalbed methane reservoir as described
10 in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of avoiding production from wells that are not economic.
108. A method of evaluating an undersaturated coalbed methane reservoir as described
15 in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of characterizing a plurality of wells prior to beginning commercial methane production.
109. A method of evaluating an undersaturated coalbed methane reservoir as described
20 in claim 108 wherein said step of characterizing a plurality of wells prior to beginning commercial methane production comprises the step of characterizing a plurality of wells in a reservoir area prior to beginning commercial methane production.
- 25 110. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 100 wherein said step of accessing a well admitted to an undersaturated coalbed methane reservoir comprises the step of accessing a low permeability well admitted to an undersaturated coalbed methane reservoir.
- 30 111. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 100 wherein said step of accessing a well admitted to an undersaturated

coalbed methane reservoir comprises the step of accessing a shut in well admitted to an undersaturated coalbed methane reservoir.

112. A method of evaluating an undersaturated coalbed methane reservoir as described
5 in claim 100 wherein said step of accessing a well admitted to an undersaturated coalbed methane reservoir comprises the step of accessing an unproductive well admitted to an undersaturated coalbed methane reservoir.

113. A method of evaluating an undersaturated coalbed methane reservoir as described
10 in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of obtaining multiple samples of formation water from said well.

114. A method of evaluating an undersaturated coalbed methane reservoir as described
15 in claim 1 wherein said step of characterizing said coalbed methane reservoir based upon said inductively quantified methane content characteristic comprises the step of estimating a dewatering value for said well.

115. A method of evaluating an undersaturated coalbed methane reservoir as described
20 in claim 1 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of conducting multiple similar sampling of said formation water from said well, wherein said step of conducting a test based on said formation water sample comprises the step of conducting multiple similar tests on said formation water samples, and further
25 comprising the step of comparing the results of said multiple similar tests to determine accuracy of said tests.

116. A method of evaluating an undersaturated coalbed methane reservoir as described
30 in claim 113 and further comprising the step of achieving a constancy in said multiple samples of formation water from said well.

117. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of altering a production rate from said well.
118. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of conducting a test based on said formation water sample comprises the step of factoring in composition of gases obtained from said well.
119. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of altering a choke valve in said well.
120. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant gas-water ratio result for said formation water.
121. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant bubble point result for said formation water.

122. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant critical desorption pressure result.
123. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of capturing both gas and water from said well.
124. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling both formation water and solubilized methane.
125. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 123 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling both formation water and desolubilized methane.
126. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling timeframe.
127. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 126 wherein said step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling

timeframe comprises the step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling timeframe selected from a group consisting of: at least about multiple hours, at least about a day, at least about multiple days, and at least about a week.

5

128. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially stable flow rate at the time of said sampling.

10

129. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling only when achieving a substantially constant fluid production at the time of sampling.

15

130. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of producing from said well until a measured value is constant.

20

131. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of effecting only a small drawdown.

25

132. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of maintaining a pressure at at least a bubble point of said formation water.

30

133. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 116 wherein said step of accessing a well admitted to an undersaturated coalbed methane reservoir comprises the step of producing from a new well from at least one day prior to accomplishing said step of sampling formation water from said undersaturated coalbed methane reservoir.
134. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 1 and further comprising the step of assessing a saturation character of said well.
135. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 134 wherein said step of assessing a saturation character of said well comprises the step of determining a water production of said well at about the time of initial production from said well.
136. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 134 wherein said step of assessing a saturation character of said well comprises the steps of:
- a. determining a gauge pressure from said well; and
 - b. determining a reservoir pressure for said undersaturated coalbed methane reservoir.
137. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 136 wherein said step of assessing a saturation character of said well comprises the step of comparing said gauge pressure to said reservoir pressure.
138. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 134 wherein said step of assessing a saturation character of said well comprises the step of evaluating said well over a relatively long sampling timeframe.

139. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 138 wherein said step of evaluating said well over a relatively long sampling timeframe comprises the step of evaluating said well over a relatively long sampling timeframe selected from a group consisting of: at least about one hour, at least about multiple hours, at least about a day, and at least about multiple days.
140. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 115 wherein said step of conducting multiple similar tests on said formation water samples, and further comprising the step of comparing the results of said multiple similar tests to determine accuracy of said tests comprises the steps of:
- a. accomplishing initial production from said well for a relatively long pre-sampling period;
 - b. initially sampling formation water from said undersaturated coalbed methane reservoir;
 - c. accomplishing additional production from said well for a relatively long sampling period;
 - d. additionally sampling formation water from said undersaturated coalbed methane reservoir; and
 - e. comparing results of said initial sampling and said additional sampling.
141. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 140 wherein said step of accomplishing initial production from said well for a relatively long pre-sampling period comprises the step of accomplishing initial production from said well for a relatively long pre-sampling period selected from a group consisting of: at least about multiple hours, at least about six hours, at least about twelve hours, at least about a day, at least about multiple days, and at least about a week.

142. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 140 wherein said step of comparing results of said initial sampling and said additional sampling comprises the step of comparing results of said initial sampling and said additional sampling for constancy.
- 5
143. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 142 wherein said step of accomplishing additional production from said well for a relatively long sampling period and said step of additionally sampling formation water from said undersaturated coalbed methane reservoir are repeated
- 10 until said step of comparing results of said initial sampling and said additional sampling for constancy yields a constant result.
144. Methane produced by use of any of the foregoing methods.
- 15 145. A method of evaluating an undersaturated coalbed methane reservoir comprising the steps of:
- a. accessing an existing unproductive well admitted to a coalbed methane reservoir;
 - b. sampling formation water from said coalbed methane reservoir;
 - 20 c. conducting a test based on said formation water sample; and
 - d. estimating an economic factor for commercial production from said well based upon said step of conducting a test based on said formation water sample.
- 25 146. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of accessing an existing unproductive well admitted to a coalbed methane reservoir comprises the step of accessing an existing water producing well admitted to a coalbed methane reservoir.
- 30 147. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of estimating an economic factor for commercial

production from said well based upon said step of conducting a test based on said formation water sample comprises the step of estimating when said well is likely to commercially produced methane.

- 5 148. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of accessing an existing unproductive well admitted to an undersaturated coalbed methane reservoir comprises the step of assessing a saturation character of said well.
- 10 149. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of conducting any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.
- 15 150. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of conducting a test based on said formation water sample comprises the step of conducting any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.
- 20 151. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 145 wherein said step of estimating an economic factor for commercial production from said well based upon said step of conducting a test based on said formation water sample comprises the step of utilizing any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.
- 25
152. A dynamic method of surface sampling subsurface formation water comprising the steps of:
- a. accessing a well admitted to an undersaturated coalbed methane reservoir;
 - b. assuring that a formation water sample is representative of fluid from said
- 30 undersaturated coalbed methane reservoir;

- c. initially sampling formation water from said undersaturated coalbed methane reservoir;
- d. conducting an initial test based on said initial formation water sample;
- e. additionally sampling formation water from said undersaturated coalbed methane reservoir;
- f. conducting a similar test based on said additional formation water sample;
- g. comparing results of said initial sampling and said additional sampling; and
- h. achieving a constancy in said comparing the results through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir.

153. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of altering a production rate from said well.

154. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of conducting a test based on said formation water sample comprises the step of factoring in composition of gases obtained from said well.

155. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of altering a choke valve in said well.

156. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the

results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant gas-water ratio result for said formation water.

5

157. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant bubble point result for said formation water.

10

158. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially constant critical desorption pressure result.

15

159. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of capturing both gas and water from said well.

20

160. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling both formation water and solubilized methane.

25

161. A dynamic method of surface sampling subsurface formation water as described in claim 159 wherein said step of sampling formation water from said

30

undersaturated coalbed methane reservoir comprises the step of sampling both formation water and desolubilized methane.

- 5 162. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of additionally sampling formation water from said undersaturated coalbed methane reservoir comprises the step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling timeframe.
- 10 163. A dynamic method of surface sampling subsurface formation water as described in claim 162 wherein said step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling timeframe comprises the step of additionally sampling formation water from said undersaturated coalbed methane reservoir over a relatively long sampling
15 timeframe selected from a group consisting of: at least about multiple hours, at least about a day, at least about multiple days, and at least about a week.
- 20 164. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of achieving a substantially stable flow rate at the time of said sampling.
- 25 165. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of sampling only when achieving a substantially constant fluid production at the time of sampling.
- 30 166. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of achieving a constancy in said comparing the results of said multiple similar tests through alteration of actions affecting said step of sampling formation water from said undersaturated coalbed methane

reservoir comprises the step of producing from said well until a measured value is constant.

- 5 167. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of effecting only a small drawdown.
- 10 168. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of maintaining a pressure at at least a bubble point of said formation water.
- 15 169. A dynamic method of surface sampling subsurface formation water as described in claim 152 wherein said step of accessing a well admitted to an undersaturated coalbed methane reservoir comprises the step of producing from a new well from at least one day prior to accomplishing said step of sampling formation water from said undersaturated coalbed methane reservoir.
- 20 170. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 152 wherein said step of sampling formation water from said undersaturated coalbed methane reservoir comprises the step of conducting any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.
- 25 171. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 152 wherein said step of conducting a test based on said formation water sample comprises the step of conducting any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.
- 30 172. A method of evaluating an undersaturated coalbed methane reservoir as described in claim 152 wherein said step of estimating an economic factor for commercial

production from said well based upon said step of conducting a test based on said formation water sample comprises the step of utilizing any of the foregoing methods of evaluating an undersaturated coalbed methane reservoir.